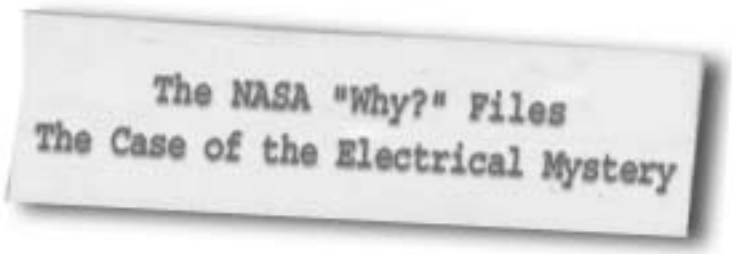

Segment 4

It is down to the wire for the tree house detectives as they try to find the solution to the electrical mystery. KSNN reports that the power outage may be due to public damage, but the tree house detectives are not sure what public damage is all about. They meet up with a utility crew to find out, and they also learn about kilowatts, voltage, and how power is measured. When observing Mr. Utility marking lines on a neighbor's property, they conclude that Mr. E did not have his yard marked prior to the installation of his fence. So once again by using scientific investigation, the current facts, and good reasoning, the tree house detectives conclude that Mr. E damaged an underground line and caused the power outage! Finally, they are able to go swimming!

Vocabulary

kilowatt hour - a measurement of energy that is equal to 1000 watts of power used for one hour

Mister/Miss Utility - a person who provides a service to people wanting to know where power lines are located before they dig in their yards

public damage - damage to a power line that is created by someone other than a utility crew and which causes a power outage

short circuit - a break in the circuit as a result of too much current flowing at once

substation - a branch of a power plant where very high voltage electricity is changed into lower voltage electricity

transformer - a device that converts electricity from a substation into a current and voltage that can be used by homes

Video Component (15 min)

Before Viewing

1. Briefly summarize and discuss the events in segment 3 with the students.
2. Review the K-W-L chart that the class created earlier (p. 11). Continue to add items in the third column, "What have you **learned**?" Are there other ideas you would like to add to the "What do we **want** to find out" list?
3. The tree house detectives are so close to finding the answer to the electrical mystery! Discuss what the tree house detectives might investigate next.

After Viewing

1. Discuss the students' reactions to the solution of the problem for the power outage and Dr. D's train set. Were their predictions correct?
2. Continue working with the display board to reinforce the investigative steps the tree house detectives took to solve the problem.
3. Choose from the activities in this packet and on the web site to reinforce the concepts being emphasized.
4. Have students research how electricity use is measured. Contact your local utility company for information and demonstration equipment.
5. Have students discuss how they can conserve energy in their homes, schools, and other familiar locations.
6. Ask your local utility company about preventing public damage. Research your local contact numbers and precautions that every citizen should know.
7. Research and discuss alternative fuels for power.

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Resources

Keen, Dan and Bob Bonnet: *Science Fair Projects with Electricity and Electronics.* Sterling Publisher Company, Incorporated, 1997, ISBN 0806913010

Pratt-Van Cleave, Janice: *Janice Van Cleave's Electricity: Mind-Boggling Experiments You Can Turn into Science Fair Projects.* Wiley, John and Sons, Incorporated, 1994, ISBN 0471310107

Careers

Mr./Miss Utility
lineman
electrician

Activities and Worksheets

In the Guide

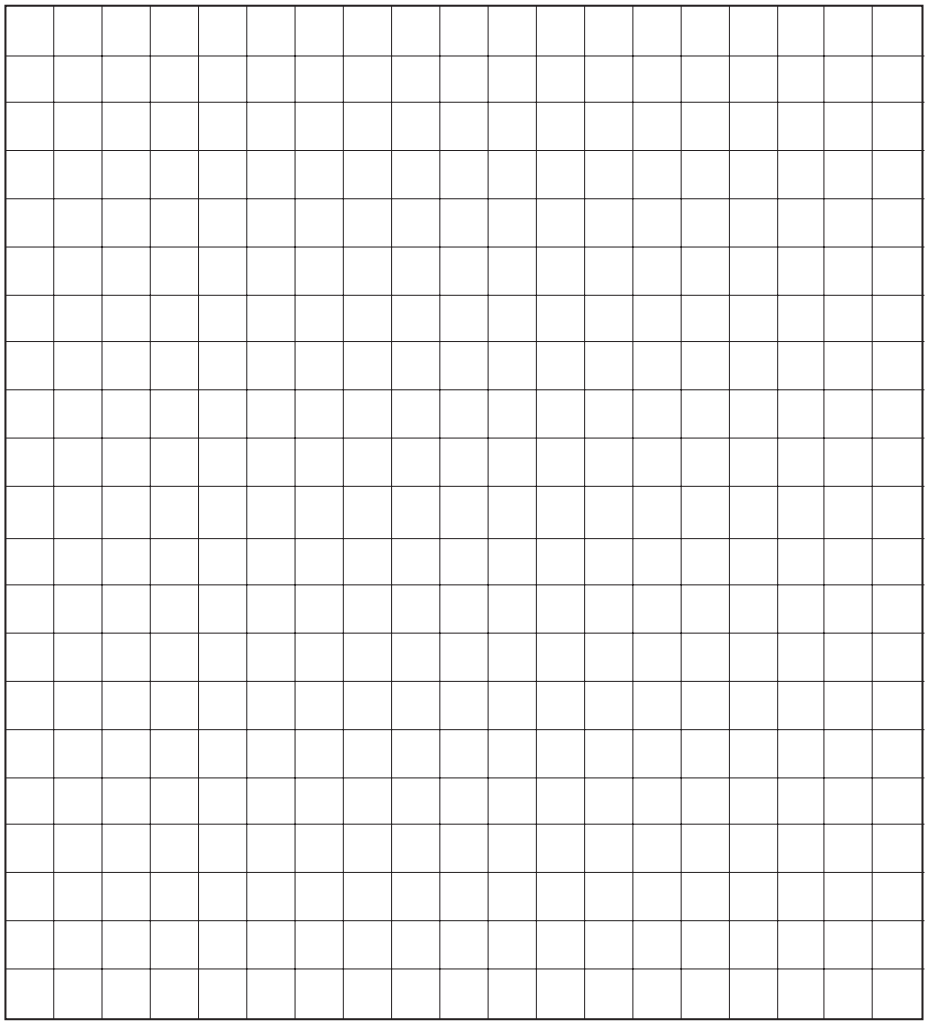
On the Web

You can find the following activities on the Web at http://whyfiles.larc.nasa.gov.

Electricity Concept Map
A concept map that illustrates the major concepts of the video.

Shocking Scientists
Research electrical inventors to learn more about the history of electricity.

Vocabulary Crossword Puzzle



Create a crossword puzzle with the following terms and the grid below.

Vocabulary

circuit
conductor
load
series circuit
switch
insulator
voltage
parallel circuit
electricity
repel
current
kilowatt

Add your own:

_____

_____

_____

_____

Across

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Down

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Word Search

I I L L E C R A L O S O S E C H
F N R E S I S T O R R T A N D Y
I S O X H D K O A S E R I E S D
E U T T N C M A D C T A J R E R
L L C Z Z B T K D L I N N G D O
E A U S T A T I C F U S O Y U E
C T D N E T X L W U C F R V B L
T O N E U T R O N S R O T W Y E
R R O U L E O W C E I R C S P C
I C C H E R H A I E C M E W R T
C Z S U A Y D T Y W V E L N O R
I O T A V O L T A G E R E Y T I
T I R G E N E R A T O R O V O C
Y P A R A L L E L A M O T A N O

battery
circuit
current
energy
generator
kilowatt
load
solar cell
hydroelectric
fuse
conductor
insulator
resistor
series
parallel
switch
voltage
transformer
atom
neutron
electron
proton
static
electricity

Measuring Electricity 101

Most electrically powered devices in your home use different amounts of electricity. The most commonly used unit of energy to measure electricity is the watt. (Note: The watt (W) was named after the Scottish engineer and inventor James Watt.) To measure large quantities of power, such as the power in your home, the kilowatt (kW) is used. A kilowatt (kW) is equal to 1,000 watts of power.

To calculate how much energy a device in your home or school uses, multiply the number of watts the device has by the number of hours the device is used. For example, if you burn a 60-watt bulb for 2 hours, you have used 120 Wh (watt hours). Large quantities of electricity are measured in kilowatt-hours (kWh). One kilowatt-hour is equal to 1,000 watts of electricity used for one hour (1,000 Wh).

Complete the table by determining first the number of watt hours and then the number of kilowatt hours. The first one is done for you.

Appliance	Power (W)	Hours Used	Watts/hour	Kilowatts/hour
Lava lamp	100 W	3 hours	300 Wh	0.3 kWh
Electric Coffee Pot	1500 W	10 hours		
Curling Iron	825 W	4 hours		
Vacuum Cleaner	642 W	60 minutes		
Portable Radio	120 W	120 minutes		
Light Bulb	150 W	90 minutes		

Electrifying Math

In science, the scientific method is a common process used to solve a problem. In mathematics there are also strategies used to solve mathematical problems. Choose a strategy from the chart below to solve the following problems.

Mathematical Strategies

Choose an operation.

Make a drawing.

Use guess and check.

Make a list.

Use a chart.

Use logic.

Use estimation.

Work backwards.

1. John and Patrick are not careful about turning off electrical appliances that they are no longer using. John leaves his desk lamp on all day. That 60 W light bulb burns 10 hours a day. What a waste! Patrick leaves his 110 W television on each day from the time he gets home from school at 4 PM until he goes to bed at 9 PM.

   How many watt-hours of electricity does Patrick waste a day?_____

   How many kilowatt-hours do they use combined in a day? _____

   If the utility company charges 10 cents a kilowatt, how much money is spent on these wasteful habits each day? _____

2. Helen and her family decided to reduce their energy consumption, but they need to develop a plan for the household use. They have developed a list of appliances they use each day and the wattage required for each item. Use the data to help them make the most efficient household energy plan.

   It takes 1 hour to cook a potato in an oven and 12 minutes in a microwave. Helen wants to cook a potato for lunch. Which appliance will be the better choice? Why?

   _____

   _____

   Helen's brother wants to read his novel. He normally spends one hour reading each night. He can read in the dinning room or in the living room. Which room would be the best room to read in if he wanted to be energy efficient? Why?_____

   _____

   _____

   Helen's mother washes the family dog once a month. She normally dries the dog's hair with a hair dryer for about 20 minutes. Would it be more efficient to set the dog in front of the fan for an hour? Is the most efficient way always the best? Explain your reasoning. _____

   _____

   _____

   _____

   _____

   _____

Appliance Power in watts (W)

microwave 1, 500 W

oven 3, 250 W

hair dryer 1, 875 W

chandelier (dinning room) (5) 60 W bulbs

lamp (living room) 125 W

television 110 W

small desk fan 90 W

Electrifying Energy Survey

Purpose

To provide students with experience in making observations of electrical energy usage of several appliances in their home.

Materials

data collection sheet
pencil

Before Activity

The teacher should prepare a large duplicate of the data collection sheet on bulletin board paper or on the chalkboard.

Procedure

1. Place students in teams of three or four.
2. Distribute the data collection sheets. (See p. 58.)
3. Ask each team member to select 2-4 appliances they would like to investigate in their home. The students will need to be able to find the power usage of each device chosen. You may wish to give this information to the students beforehand.
4. Explain that they will only fill in the first 3 columns of the data sheet. The other two columns will be completed in class when they are brought back.
5. Give the students a time frame (3 days to 1 week) in which to keep track of the daily usage of the appliances they chose. Students should note the due date for the assignment on their data sheets.
6. On the class data collection sheet that you prepared, model a few examples of how to complete the table.
7. Upon completion of the assignment, have the students bring their data collection sheets in and share their data as a class.
8. Record their data on the large class chart. Note: If more than one student collected data on the same appliance, have those students average the data and record only the average on the chart.
9. Discuss the following questions once the data is recorded:
   - Which three appliances use the most electricity?
   - Which three appliances use the least electricity?
   - Which room in the house do you think uses the most electricity?
   - How could you reduce the amount of electricity your family uses?
   - Give students the current rate of electricity per kWh for your area. The rate can be found on your utility bill or by calling the power company.
10. Model how to find the cost per week or month of items on the data sheet.
11. Have students work as a team to determine the cost per month for the appliances their team investigated.
12. As a class, record the costs on the class chart.
13. Once all items have been recorded, discuss the following questions:
    - Which three appliances cost the most to use?
    - Which three appliances cost the least to use?

Conclusion

1. Do all households use the same appliances? Explain why or why not.
2. Explain how households might use appliances for different lengths of time.
3. How could you reduce the cost of your family's electric bill each week/month?

Extensions

Give students a power budget of about 5,000 watts per hour. Have them try to get through a typical day without going over their budget.

Electrifying Energy Survey: Data Collection Sheet

Before buying a new appliance, you can determine the amount of electricity the appliance will use. This information will allow you to compare similar appliances so that you can purchase the most energy efficient appliance. Most new appliances have a tag that looks similar to the one at right:

Model CDF 102
2000 watts 175

This tag identifies the model number and power of the item. Remember that power refers to how much energy it takes to run an appliance and is measured in watts. The power rating on the tag above shows that the item would use 2000 watts. To find the amount of energy used for this appliance, you multiply the power rating by the amount of time that the appliance is used. If the appliance is used for two hours consistently then the math would look like this:

2000W x 2 hours = 4,000Wh or 4kWh

An older appliance in your home might still have the tag. On some appliances such as toasters and televisions, the wattage may be printed on the bottom or back of the device. You may need to do a little detective work and have an adult find the manual to the appliance you are investigating. The manual should have the wattage listed.

How Much Energy Do Household Appliances Use?

Appliance	Power (kW)	Time used (hr./wk or hr./month)	Energy per week or month (kWh)	Cost per kWh	Cost per week or month
Refrigerator					
Microwave					
Clothing iron					
Hair dryer					
Electric range					
Washing machine					
Portable radio					
Television					
Desk lamp					
Blender					
Coffee pot					
Alarm clock					
Stereo system					
Cloths dryer					
Computer					
Video game					
Electric blanket					
Toaster					
Other					

Meter Reader

Purpose

Students will learn how to read a meter to calculate electricity usage.

Materials

practice meter reader sheet
home meter reader sheet
pencil

Procedure

1. Explain how electricity is measured in homes and offices. Tell students that they will be learning how to read a meter to determine how much electricity they use in their homes.
2. Review place value with the students.
3. Distribute the practice meter reader sheets (p. 60) and go over the rules for reading a meter that are located on the practice sheet. Reference the dials and show how they represent place value of a number (ones, hundreds, thousands, and ten-thousands).
4. Students practice reading meters.
5. Go over answers to make sure that the students understand the process.
6. Distribute the home meter reader sheets and ask students to read their meter at the same time each day for four days.
7. Students bring their meter reader sheets to class and calculate how much energy they have used.
8. Discuss and compare the amounts of energy used.
9. Arrange students in groups that represent the different types of homes: apartments, houses, trailers, condos, and so on. Average the energy usage among groups and graph the data. Ask students if they can draw any conclusions from the graph. Why or why not?

Conclusion

1. How did your energy usage compare day to day?_____

2. Explain why usage did or did not differ._____

3. How could you save electricity in your home? List at least three ways._____

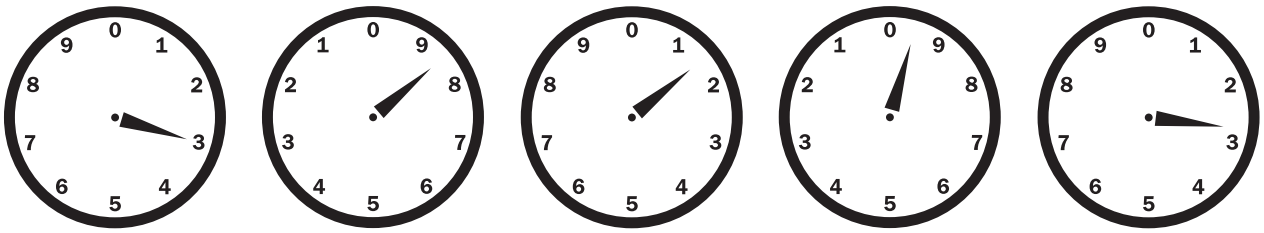
Extension

1. Calculate the cost of the amount of energy used per household.
2. Calculate the cost of the amount of energy used by the whole class.
3. Measure and calculate the amount of energy used by the school.

Meter Reader (continued) Practice Sheet

Rules to follow when reading a meter:

- Always read the faces of the meter from left to right.
- The dials of a meter are like watch faces; however, EVERY OTHER DIAL MOVES COUNTERCLOCKWISE.
- If the pointer is between two numbers, always record the number it has just passed. That will be the smaller number, except when passing from 9 to 0; the 0, in that case, represents a 10.



1. _____ _____ _____ _____ _____

2. _____ _____ _____ _____ _____

3. _____ _____ _____ _____ _____

Meter Reader (continued) Home Sheet

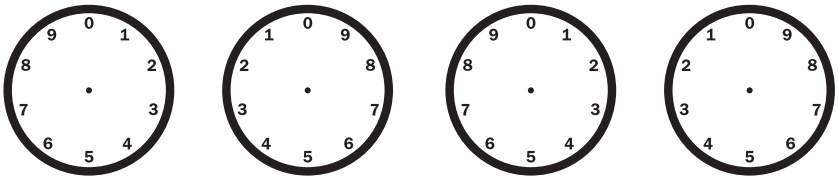
Rules to follow when reading a meter:

- Always read the faces of the meter from left to right.
- The dials of a meter are like watch faces. However, EVERY OTHER DIAL MOVES COUNTERCLOCKWISE.
- If the pointer is between two numbers, always record the number it has just passed. That will be the smaller number, except when passing from 9 to 0; the 0, in that case, represents a 10.

Directions

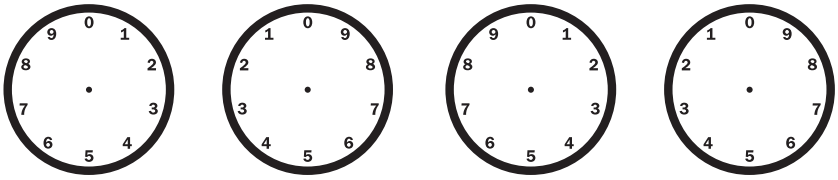
1. Draw hands as they appear on your meter at home.
2. Record number on the line below dial.

Day 1 Beginning Meter Reading



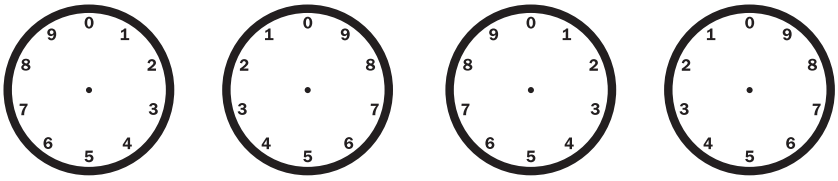
1. _____ _____ _____ _____

Day 2 Meter Reading



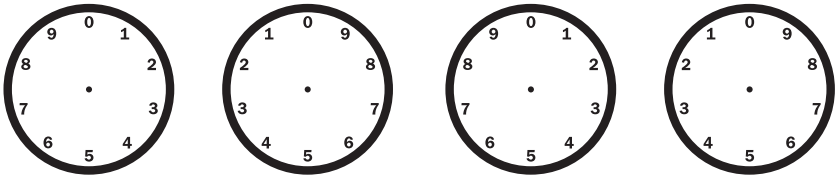
2. _____ _____ _____ _____

Day 3 Meter Reading



3. _____ _____ _____ _____

Day 4 Final Meter Reading



4. _____ _____ _____ _____

1. To calculate how much energy you used daily, take the beginning (day 1) reading and subtract the day 2 reading. To calculate the next day's usage, take the day 2 reading and subtract the day 3 reading and so forth.

2. To calculate total energy usage, take the beginning (day 1) reading and subtract the day 4 meter reading.

Answer Key

Electricity Concept Map (on the web)

1. flowing water
2. batteries
3. watts
4. negative
5. static electricity

Measuring Electricity 101

1. 300 Wh and 0.3 kWh
2. 15,000 Wh and 15 kWh
3. 3,300 Wh and 3.3 kWh
4. 642 Wh and 0.642 kWh
5. 240 Wh and 0.24 kWh
6. 225 Wh and 0.225 kWh

Electrifying Math

1. 550 Wh, 1.15 kWh, $0.12
2. microwave; answers will vary; living room, because it is less wattage; yes, answers will vary.

Meter Reader Practice Sheet

1. 38192
2. 62579
3. 62606
4. 9486
5. 2620
6. 8702